EXERCISE SHEET 2

Exercise 1:

Calculate the fluctuating force term $g_\mu = \dot{\mu}$ in order to show that

$$D_{\mu\mu}(\mu = \pm 1) = 0.$$

Use the Lorentz force and a representation of the momentum in cylindrical coordinates.

Exercise 2:

Solve the diffusion equation

$$\frac{\partial M(z,t)}{\partial t} = \kappa_{zz} \frac{\partial^2 M(z,t)}{\partial z^2}$$

by using the ansatz $M(z,t) = \rho(t)P(z)$ and a sharp initial distribution function $M(z,0) = \delta(z - z_0)$. Illustrate the temporal evolution of the particle density M for a given parameter z.

The following integral might be useful

$$\int dx \; \exp(-ax^2 + \imath bx) = -\frac{\imath\sqrt{\pi}\exp(-b^2/(4a))\,\mathrm{Erfi}(b + 2\imath ax/(2\sqrt{a}))}{2\sqrt{a}},$$

as well as the imaginary error function $\mathrm{Erfi}(x) = -\imath \mathrm{Erf}(ix)$ and the approximation $\mathrm{Erf}(x) \approx 1$ for $x \gg 1$.